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Nokia – The Inside Story

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Understanding Nokia's explosive growth

Nokia is nothing less than a national institution in Finland because of its contribution to the national economy and its long history, but the keen interest in the company today stems more from its recent success as Finland's first real world-class corporation.

Yet this global role has been achieved so quickly and so quietly that the story of Nokia's rise to world prominence is little understood. Outsiders are fascinated by the Nokia story, as am I, and I shall tell it from my historian's perch in a way that provides a clear and complete record, focussing especially on the past 25 years.

In the opening three chapters I attempt to answer some of the most frequently asked questions about the company, with a more detailed account to follow in later chapters. Links are indicated in the text for quick reference to the detailed story.

Unlike many other published articles, books and studies of Nokia, this history was made possible in large part by unlimited access to documents in Nokia's files, most of them confidential until now. As a historian and researcher, I have applied academic rigor to these and all other sources of information.

I was offered the opportunity by Nokia to write an honest, complete and credible history of the company, and was able to operate without interference from any quarter. I had a free hand to pick and choose the areas I would examine. Over five years, I tracked down and interviewed numerous past and present executives and other players around the Nokia story, and had their personal files at my disposal. Based on this largely untapped wealth of material, I published at the end of 2001 a 975-page, fully documented Finnish-language history of Nokia, covering the period from 1865 to the end of 2000. The volume at hand is an abridged English-language edition of that book.

NOKIA~

CONNECTING PEOPLE

The logos of three original companies that formed Nokia Corporation, in 1967 The oldest was Nokia Ab (est. 1865) in the forest industry and power production. Suomen Gummitehdas Oy (Finnish Rubber Works, est. 1898) was manufacturing galoshes and other rubber products, and Suomen Kaapelitebdas Oy (Finnish Cable Works, est. 1912) was producing telephone and power cables. The current Nokia logo dates from 1992. The arrows were later dropped.

To be credible and have sustainable value, a good history must cover all relevant aspects of its subject, including the bad judgments and wrong turns. Nokia has had its moments of glory but also has seen times of grave crisis, at times facing the dangers of hostile takeover or financial ruin. All the major ups and downs are in this book. Painful events such as the death of Chief Executive Kari Kairamo by his own hand, the confusing corporate governance situation in 1986-1992, and the massive losses of the Consumer Electronics division are described as accurately as present documents and sources allow.

Secrets of success

• Of course one question soars above all others: What explains Nokia's phenomenal rise to the status of a global giant in the 1990s? Even as I described the company's earlier stages, I could feel that the story was overshadowed by that all-embracing question.

It is a long and complex story. From its early years, Nokia was an important part of Finnish industrial history. Beginning in the late 1980s, it was among the leaders in Europe's industrial development, and in the 1990s became a major player on the global stage. The issue of moving away from Finland closer to customers and sources of international money has arisen over and over but management has always come down in favor of staying home. Nokia is a Finnish company and proud of it. The gleaming new "Nokia House"

corporate headquarters at Keilalahti in the seaside town of Espoo on the outskirts of Helsinki is an architectural landmark.

Nokia's dynamic evolution is a story of how visionary industrial thinking and courageous decisions have enabled a company on the edge of Western Europe to grow rapidly into a truly global force. Investors, customers and business partners throughout the world have been touched by the Nokia story and undoubtedly will continue to be. For Nokia is the kind of company that thinks of, plans for, and influences the future of its industry.

Nokia is the first Finnish brand to be recognized by the general public throughout the world. In its home market, Nokia and its antecedent companies have ranked among the biggest for decades. So perhaps the question should be: How did a large Finnish company grow first into a European force, then rise to the status of global giant? A key part of the answer is the management's business acumen and its ability to reinvent the company continuously around sectors that seemed the most promising at the time - even if this meant divesting businesses that once formed the very core of the firm.

A second theme in this book is the interaction between technological and organizational innovations, as well as between profit-oriented business operations and the regulatory measures of public authorities.

Accumulation of knowledge is a characteristic feature in the history of technology. New inventions borrow from older ones and eventually replace them. Yet industrial success is also about people and organizations. Their knowledge does not accumulate the same way. I have become convinced that a political system cannot produce technological innovation, but it can do a great deal to prohibit, slow down and create obstacles to it. The process of adoption of innovations is a fruitful area for further research.

Business economics forms a third theme, a kind of gray area between technology and people. It is a mix of science and emotion. On the one hand it represents security, clarity and sustainability. On the other hand it encompasses human weaknesses such as inexperience, prejudice and dreams.

Business and politics

- The development of new technologies depends not only on technical features and commercial opportunities but also on political decisions. Cellular telephone technology offers a prime example of how to operate

in this labyrinth. While digitalization of voice is based on technological progress, the allocation of radio frequencies and deregulation is pure politics. Any company's performance in this sector depends upon a mix of those two forces.

In this book I am examining Nokia's strategy primarily from the point of view of the owners and management. One of the key issues deals with the question of the conglomerate: How best to choose the business areas in which it ought to invest? Secondly the book aims to shed light on the internal business logic and major events taking place in the various business areas. Corporate governance, the functions of top management and large shareholders, are also covered extensively. This includes the ownership structure, shareholders' impact on Nokia's management, roles and responsibilities of the various governing bodies, as well as the organization and functioning of top management. All of these have had a profound impact on the company's history.
In these pages I also describe those circumstances, external decisions and realities that have influenced Nokia's operating environment. Nokia had to adapt to changing circumstances, but it has also been able and willing to shape the external environment.

It is important that all decisions made during Nokia's extensive history be examined against a framework of Finnish, global and political circumstances prevailing at the time. The 137-year history of Nokia spans world wars and revolutions. There have been closed and regulated economies, and also periods of deregulation. At times galloping inflation and sky-high interest rates played havoc with financing strategies, which were then followed by deflation and low interest rates. Deep recessions and overheated economies have by turns kept businesses on their toes. Finland has looked toward the East at the time of the Cold War, then turned to the West as it became a member of the European Union. And finally, Nokia is equally familiar with protectionism and the economic freedom of globalization.

If this book has a message for others seeking success, it would be a plea for flexibility and open-mindedness. Only with those qualities can a company in today's volatile global environment hope to prosper.

To simplify this story for the non-European reader I often use the name 'Nokia' rather freely to describe the company in its past incarnations, its present structure, and for some of its joint ventures and divisions.

And to make financial discussions simpler to follow, all euro conversions are calculated on average 2000 exchange rates unless otherwise specified.

Nokia and its predecessor companies

THREE INDEPENDENT COMPANIES

THE DE FACTO GROUP OWNED BY RUBBER WORKS

Nokia -1 1918

Forest and Power - -- -- -

NOKIA CORPORATION IN 2002 Nokia Mobile Phones IN:.: I:)] (NET)' Nokia Ventures Organization (NVO) Nokia Research Center (NRC)

Nokia Mobile Phones 1989

Nokia-Mobira 1986-1989 Mobira 1979-1986

OFFICIAL MERGER 1967

Nokia Corporation (Oy Nokia Ab 1966-1997 Nokia Oyj 1.9.1997-)

Finnish Rubber Works

Nokia Networks 1999

Nokia Telecommunications 1992-1999

Telenokia 1981-1992 Televa 1976-1981

1922 Finnish Cable Works

1865	1898	1912
Nokia	Finnish Rubber	Finnish Cable Works
Forest and Power 1865-1966	Works 1898-1966 (Suomen Gummitehdas Osakeyhtio, Suomen Kumitehdas Osakeyhtio)	Suomen Punomoteh das Osakeyhtio ,1912-1916 Suomen Osakeyhtio 1917-1966

CHAPTER 1

The fading of time and place?

In my view, the third industrial revolution, the breakthrough of computers and telecommunications in which Nokia played a part, has been somewhat oversold as `the fading of time and place'. Curiously, the very same words were used to explain the impact of the expansion of railway networks in the 19th century. Faster land transport led people to believe that the fundamentals of the economy had somehow changed, and that time and place would never be the same.

In discussing the 1990s we face the same question about whether fundamental change has taken place, and the answer is `yes and no'. It is true that telecommunications has become vitally important, it has widespread influence on the economy and on personal life, and indeed it has turned into one of the world's leading industries. Yet there is a difference compared to the advances of the 19th century. Although the mobile telephone and Internet connections can reach the remotest parts of the globe, they have hardly 'faded time and place', let alone altered the fundamentals of the industrial world.

Nokia's operating environment brought major changes in the 1990s, but not nearly as great as those ten years earlier, not to mention the changes in the second decade of the 20th century or in the 1940s when the world wars redrew the map of Europe and Asia. In many respects, this is a story of continuity. Three companies - Suomen Gummitehdas Oy (Finnish Rubber Works), Nokia Ab, and Suomen Kaapelitehdas Oy (Finnish Cable Works) - formed the roots of Nokia (see Chapter 4). They were all industrial companies, as is Nokia today. The modern Nokia manufactures and sells industrial products that require substantial expertise, as did the antecedent companies.

The computer emerged as the primary industrial engine in the 1980s. It launched the 'third industrial revolution' much like the first revolution was powered by the steam engine at the beginning of the 19th century,

The Snake Game is a prime example of how the use of industrial products assumes unpredictable forms. Other features in mobile phones include (among many others) the clock, a calendar, short message facility, wake-up calls and a calculator. The Snake Game is the most popular; competitions are organized with rankings of the best scores.

and the second revolution was driven by electricity at the beginning of 20th. The fundamentals of the economy still remain. Structural changes are brought about by inventions, tremendous growth figures in new business areas, variations in obstacles to world trade and national regulatory measures - and, of course, speculation on the stock markets.

The rise to global prominence

• My primary interest in this book is Nokia's industrial activity, how its businesses have evolved and changed, how its operational results have developed at various junctures, how research and development have been carried out and how the company has been managed.

Nokia became a world-class corporation during the second half of the 1990s, riding mainly on the back of the growth of telecommunications. Three factors have contributed to the development:

- Deregulation of operators opened competition in the field of telecommunications equipment, previously controlled by national telecom monopolies.
- Analog communications technology gradually gave way to digital technology, enabling operators to offer a host of new services and creating a steadily expanding market.
- The pan-European GSM (Global System for Mobile Communications) cellular phone standard networks first introduced in 1991 grew rapidly both in geographical scope and in functions offered.

Thus the Nokia phenomenon can be somewhat simplistically explained in one sentence: Nokia became successful in the 1990s because telecom

operators in several countries needed network equipment and phones based on the new GSM technology and they needed it fast.

Nokia's timing at this transition point was ideal. In the 1990s, the company managed to capitalize on rising demand in Europe, then repeat this success globally. It achieved a trailblazing position in technology, production efficiency, design and marketing. This can partly be explained by the experience Nokia and its wireless communications acquisition Mobira had in the cellular phone markets dating from the beginning of the 1980s. In addition Nokia could tap into its experience of building telephone networks and exchanges since the 1970s.

Also, in the 1980s, the deregulatory political winds out of the United States and the United Kingdom introduced competition to the telecom operator sector that previously had been controlled by national monopolies. New operators quickly adopted the latest technology, forcing

The opening ceremony of the new factory of Being Capitel Nokia Mobile Telecommunications Company (BNMT) and Xingwang (International) Industrial Park in December 2001. From right to left Mr. Antti Wäre, general manager of BNMT Urpo Karjalainen, president of Nokia (China) Investment Co. Ltd., Veli Sundbäck, member of Nokia Executive Board, Ouyang Zhongmou, president of China Putian Corporation, Sauli Niinistö, minister of finance, Finland, Nokia CEO Jorma Ollila, Li Rongrong, minister of the State Economic and Trade Commission, Zhang Mao, vice mayor of Bejing, Wei Jianguo, vice minister of Foreign Trade Economic Commission, Susan Fan, executive vice chairman of Nokia (China) Investment Co. Ltd.

Jenni Hannula working on Nokia's 100 millionth mobile phone at the Salo plant in Finland.

established operators to react by updating their networks and systems. Combined with the introduction of GSM, this provided equipment manufacturers with a growing market.

With hindsight, we can date the beginning of the modern Nokia success story rather precisely. Nokia received its first GSM network order in Finland in the spring of 1989 from Radiolinja Oy, the network operator established in the previous autumn by the country's private regional telephone companies. Inaugurated on July 1, 1991, Radiolinja was able to create the world's first GSM network - thanks in large part to Nokia and its equipment. Soon Nokia received large network orders from the United Kingdom, Europe, and subsequently throughout the world.

Meeting the management challenges

- But these are external factors. Another element of the success was the strength of Nokia's internal operations, and here we have seen the company confront a series of management challenges. Three crises dogged Nokia's operations in the 1990s, and recovery from each of them improved the company's competitiveness. The management team that led

Nokia through the 1990s and into the 21st century had weathered major storms.

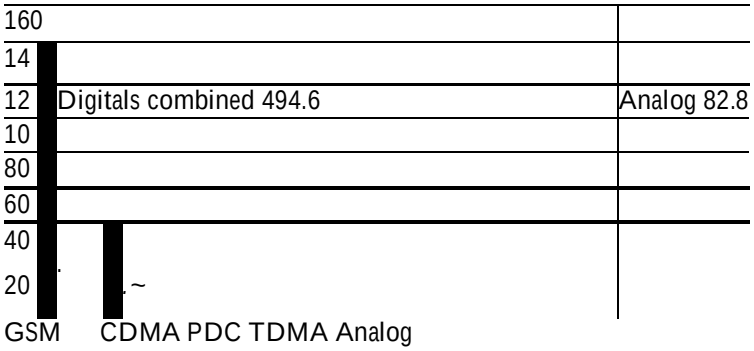
The most important lessons were drawn from the company crisis of 1987-1992. The roles of share ownership and executive management became mingled for several reasons, distorting the corporate governance mechanism. In addition both Telecommunications and Mobile Phones, the core business groups of Nokia in the 1990s, suffered unrelated crises, but each bounced back with improved efficiency.

The Telecommunications division faced the moment of truth in 1991. Profitable trade with the Soviet Union collapsed while Finland dived into a deep domestic recession that was worsened by the downturn in western markets. As a result, the Telecommunications division had to re-evaluate and redirect its operations. This enabled it to transfer experienced telecom people to the emerging GSM markets and thus strengthen resources in that area. The Mobile Phones division suffered its own severe crisis in logistics in the mid-1990s. This led to a similar re-evaluation and reorganization of production, sourcing, internal communications, inventory, financial management and several other critical functions.

Another key element in maintaining growth in the 1990s was the constant and vigorous investment in research and development. Strong R&D is essential in a field of technology where product lifespans are ever shorter (see Chapter 8). A further significant factor was Nokia's design and adoption of the common platform principle, which provides a basis for a growing and changing the product portfolio by simplifying the technology and allowing economies of scale in production.

Nokia's focus on two key industries - handsets and network equipment - is based on both internal decisions and external circumstances.

THE NUMBER OF MOBILE PHONES IN THE WORLD, JUNE 2000 180 millions



How did this Finnish cell phone maker become . the hottest tech company in Europe? Just listen to what CEO Jorma Ollila has to say.

Nokia's rapid rise on the stock markets since 1997 has made Jorma Ollila a familiar name in the international press. Yet, he has strictly limited his interviews and other appearances for the industry and corporate affairs.

Burgeoning demand in the liberalized telecommunications markets helped guide strategy. And throwing off the conglomerate structure that had prevailed since 1966 required a rethink about where the company was going and how it would get there.

Mobile phone sales had gradually assumed a key position among Nokia's businesses. With sales growing at 30-50 percent per year through

out the 1980s and well into the 1990s, profits had risen impressively in the early 1990s, and within a few years mobile phones had become one of the group's two main business areas.

By the mid-1990s, handsets were small enough and inexpensive enough to advance from the category of business tools to consumer goods with much larger market potential. With its successful market segmentation and a popular product portfolio, Nokia became the world's leading mobile phone manufacturer in 1998. Since then, each year Nokia has increased its lead.

Changes in the ownership structure helped pave the way for growth. The Finnish banks that had been for so long the dominant owners of Nokia often disagreed on key issues, including the company's financial needs. Gradually the share ownership became much more diversified. Foreign, and particularly US, institutional and retail investors today make up a sizable majority of the Nokia shareholder base.

The Ollila touch

- Nokia's success in the 1990s cannot be explained without evaluating the role of management. Overcoming strong external pressures and internal conflicts, the current team succeeded in building a strategy, a corporate culture and modus operandi that provided a structure for successful R&D as well as efficient production and sales. Under the direction of President and Chief Executive Officer Jorma Ollila, this was accomplished in a highly cost-conscious environment.

Ollila, a trained engineer and economist, focussed on profitable growth areas and management of the elements of growth. He stabilized the company's ownership by creating fluent and open relations with shareholders, and built a productive top management team while also inspiring employees. All the while, he kept the levers of change firmly under his control.

Nokia's future was now in the hands of a self-effacing but firm executive who was well prepared for the job. People who know him better regard Ollila as a very social person. He likes to run his affairs through personal contact on the phone, not on paper. He has extensive political contacts, as well as an active network of top business colleagues around the world. His ideas are often generated in informal gatherings, and he keeps in contact with colleagues by telephone, small pieces of paper and by e-mail.

Ollila did not regard Kari Kairamo, his predecessor and a highly charismatic figure, as a role model. In public appearances and speeches

Ollila prefers carefully constructed arguments. He shies away from social events, and the outside world knows little about his private life. For distraction, Ollila plays tennis, but not golf, the customary activity for his corporate peers. He has also become a keen hunter in the Finnish forests, much like the old-time Nordic patriarchs.

As a leader of people, Ollila combines the roles of orchestra conductor and solo violinist. He is the one who determines the tempo and leads the music, but at the same time he has devolved considerable freedom and responsibility to lower levels.

As opposed to a number of other executives, Ollila has been selective in accepting board memberships in other companies. His current board positions include Ford Motor Company, UPM-Kymmene (the Finnish forest products group) and Otava Books and Magazines Ltd. (the Finnish publishing house).

Learning from the past

- It was perhaps the trying experiences of the 1980s and 1990s that explain Ollila's no-nonsense corporate culture. Nokia is known as a desirable place to work but one that makes heavy demands on each employee's performance. Management communicates early on and openly with employees and investors to avoid misunderstandings when problems arise. Part of the Nokia culture is efficient implementation, and management strives to ensure that decisions are followed through. In the same vein, Ollila aims to reduce the gap between corporate vision and market reality. This does not mean lowering targets, but rather ensuring the viability of objectives.

The company seems to have acted wisely in the 1990s, refraining from costly acquisitions of the type it had made in the 1980s. Instead, the company built up its own knowhow by investing in R&D both in mobile phones and telecommunications. Thus Nokia was ready for the wave of deregulation that created global telecom markets. But it was digital technology that opened the floodgates for new services, and the emergence of mobile phones as a mass-market product.

Comparison of Nokia's rise with the lessons found in the classics of economics is striking in the case of *Capitalism, Socialism and Democracy* (1942) by Joseph Schumpeter. The Schumpeter book lists the same core elements of capitalism that can be found behind Nokia's success more than half a century later: production of consumer goods at constantly lower production costs to increasingly larger markets; continuous

innovation of products and organization - not price - as the key element of profitability, and even creative destruction (in Nokia's case in 19881991) which forms the basis for renewal.

As a world-class industrial company, Nokia has followed in the footsteps of two great models in the previous industrial revolution. First, the invention of the mass-market automobile which saw Henry Ford simplify the production line to achieve lower costs. Second is the talent of Alfred Sloan, the mastermind of General Motors' complex organization. He diversified and controlled the company systematically through key performance figures and credible argumentation.

Alfred Sloan is as good a model for Jorma Ollila as anybody. Mobile phones became a consumer goods industry during Ollila's tenure and new models were brought to market annually to suit various consumer segments. Marketing and branding were key elements while the organization was refined and restructured constantly to match changing circumstances. Driving all this was the explosive growth of a new product - the mobile phone - as was the case with the automobile in the 1920s-1950s.

When one competitor succeeds in fierce competition and others lag behind, the reasons lie not only with the winner's strategy but also with that of its competitors. I must emphasize that this is not a comparative study. Nevertheless the picture of the mobile phone markets in the 1990s would not be complete without a detailed comparison. It must one day include the decline of Motorola, the market leader in the early 1990s, and the difficulties of Ericsson, the dominant telecommunications company for several decades. To tell that story fully, however, we must await their respective documented histories.

Finland's information technology culture

• To find the answer to Nokia's success, one cannot avoid the question of Finland's role in it. How much has the country of origin contributed to this miracle? True, today Nokia has distanced itself from the mother country in terms of sales and share ownership. In both categories, Finland accounts for just a few percentage points. On the other hand Nokia's top management and technological expertise are predominantly homegrown. Nokia's Executive Board comprises only Finns, creating a homogenous working culture.

More than one-third of the total Nokia workforce is in R&D, and two-thirds of these are based in Finland. Nokia's management capability, telecommunications research and training are therefore deeply rooted in Finland.

Toward the end of 1990s, Nokia assumed a pivotal role in the program to develop Finland's higher education resources in information technology, and in the donation of equipment for the program. This initiative grew rapidly, and its scale soon equaled that of a mid-sized university. This partly explains why Nokia has remained true to its heritage and stayed in Finland (see page 116).

Nokia's home turf has also provided a receptive marketplace for the company's pioneering products. Finland is one of the world's leading countries in mobile phone penetration and computer usage. The country's high penetration figures have attracted as much international interest as does Finland's Winter War with Russia (1939-1940) and Kalevala, the national epic on emerging nationalism. Nokia's rise in the business world is perhaps the economic equivalent of these in terms of survivalism and mythology.

I have deliberately tried to avoid terms such as `information society' and `new economy', although the Nokia name is often attached to both. In fact neither can be defined in a universally accepted way. In this book I use the term `information society' merely to describe the proliferation of computers as well as telecommunications networks and the Internet. A broader definition of the telecommunications sector would include data communication networks, or infrastructure, and terminals, software and the transfer of content. Combined, these make up the world's fastest-growing industry.

`Information society' is perhaps best described by negation, explaining what it is not. The rise in the level of education, and the obscure definition of knowledge, has often been raised in this context. I don't think they are particularly relevant to the information society. Instead education and knowledge continue a process begun centuries ago. Likewise the volume and speed in production and delivery of information do not describe this era adequately. Quantitative measurement of information does not provide a key to the mystery of information society.

Exports of electric and electronic products as percentage of Finland's industrial exports and the total exports in FIM billion
(euros in parentheses, deflated to 2000 value)

1960	1 %	2.9	(0.05)
1970	2 %	9.2	(10.4)
1980	4 %	51.3	(19.8)
1990	12%	100.0	(20.2)
2000	32%	288.0	(48.4)

The electric and electronics products industry created 24,000 new jobs in 1994-97

Nokia Networks' Sonera Business Team in September 2001. From left: Jari Toivo, Timo Uusimäki, Satu Pöntinen Pekka Poutanen, Yvonne Sterman, Esa Kesänen, Elina Herttonen and Kristina Glushkova.

As in my previous research on such subjects as data transfer, the liberalization of energy markets and the emergence of GSM mobile phone operator business, it is the interdependence of three elements - technological innovation, commercial enterprise and political regulation - that form the nucleus of the history of Nokia. Each development has been analyzed against these questions: Was it due to technological innovation, change in the business enterprise, or action by public authorities?

Traditionally all countries had kept a tight rein on telecommunications for two reasons. First, control of communications is a strategic defense issue. Second, radio frequencies are a limited resource that are allocated by an established international procedure. Finland broke free because it became one of the first countries in the 1980s to open competition in all areas of telecommunications. Indeed, my main thesis is that Finland became a leader and an innovator in the global information arena due to the early deregulation of its home market and breakthroughs in the digital era. Competition then drove its rapid development and adaptation of advanced technology products and services.

A legacy of open competition

• Competition came naturally to Finland. Early on, there were two major operator groupings: the state-run Post and Telegraph Administration (renamed Tele, then Sonera), and private regional telephone cooperatives. The former had a monopoly in telegraph, trunk and international calls, mobile phone calls as well as local calls in its operating area. The latter enjoyed a monopoly in local calls in their respective operating areas. Furthermore, Finnish industry enjoyed a competitive edge as each grouping procured its equipment through open tenders. In other words Finland has always been an open market: domestic and foreign suppliers have competed for contracts with both camps.

Finnish public authorities including the cabinet, Parliament and the Ministry of Communications managed to open the markets in a controlled manner. Consequently they never had to scale back the process. At the end of the 1990s, Finnish officials still found themselves having to defend liberalization at the level of the European Union when other more restrictive countries wanted to rein in the process.

Deregulation nevertheless gathered speed in Finland with the advent of innovations such as telefax and data communications. These required new legislation, which came into effect as early as 1987. That year marks a turning point. The same year, political decisions launched competition in the fastest growing business, mobile telephony, as well as in international calls, trunk calls and local calls.

Granting licenses to competing operators prompted these players to embark on innovations, and eventually new businesses. The Helsinki Telephone Association (currently Elisa Communications) was refused a license to operate in the Nordic Mobile Telephone (NMT) network, the analog first generation wireless telephone technology. However, together with other regional telephone companies and corporate users of new services, it established Radiolinja in 1988, which won a license for the new mobile phone network based on GSM technology. A fierce political fight preceded the decision, and hectic competition followed.

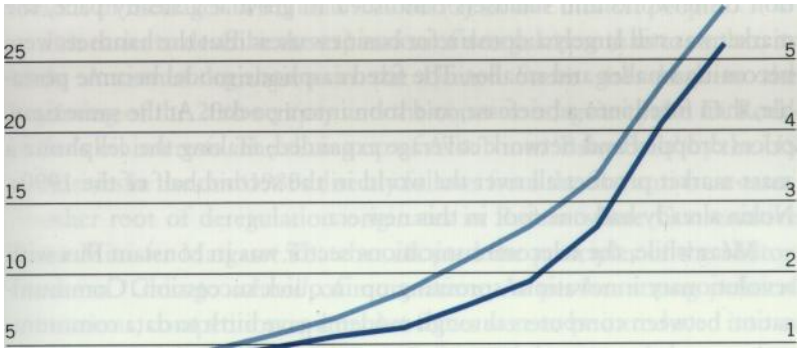
Impetus for investment

• In many cases new operators seemed to be more prepared to adopt the latest technology than the established ones because existing operators were focussed on earning back their original investment. Thus Radiolinja

NOKIA'S SHARE OF FINLAND'S EXPORTS AND GDP

30

6%



0 0 1990 1992 1994 1996 1998 2000

Nokia's share of Finland's exports, left column _ Nokia's share of Finland's GDP, right column

Source: ETLA, 2000.

embarked on the construction of the digital GSM network while the state-owned Tele was stuck with its monopoly in the analog NMT network. NMT was a significant innovation involving all the Nordic state telecom monopolies. This concept later helped untangle several key questions in the field of international radio telecommunications. NMT operated at two frequencies, first at 450 MHz, and later at 900 MHz. When inaugurated in 1981 the NMT capacity was expected to match demand until the mid-1990s. However, without the introduction of GSM, demand for mobile phones would have exceeded network capacity in just a few years.

One of the biggest events in Finland's recent industrial history took place in April 1989 when Radiolinja placed its first order with Nokia for a GSM network. This order provided Nokia with an important reference case attracting considerable international attention when GSM rapidly gained ground, largely thanks to its versatility. It can accommodate a constantly increasing number of users as well as technical innovations and new products and services (see Chapter 11).

In the context of the zeitgeist (the spirit of the times), it is worth noting that the most significant breakthrough in the world of information societies took place in 1989-1991 when at the same time as the two Germanys merged, the Cold War came to an end, centralized economies were buried and the European Union emerged as the most cohesive European force.

The mobile phone revolution, as the second major phase in the industry was called, started in the mid-1990s. While up until then the construction of networks and handsets continued to grow at a steady pace, the market was still largely a domain for business users. But the handsets were becoming smaller and smaller. The fixed carphone model became portable, then fitted into a briefcase, and soon into a pocket. At the same time, prices dropped and network coverage expanded, making the cellphone a mass-market product all over the world in the second half of the 1990s. Nokia already had one foot in this new era.

Meanwhile, the telecommunications sector was in constant flux with revolutionary innovations sprouting up in quick succession. Communication between computers through modems gave birth to data communications and the network became the arteries of modern society. The invention of fiber-optic cables increased network capacity thousands of times over and simultaneously brought prices down dramatically.

The increased capacity and cheaper price also paved the way for the latest development in telecommunications, the Internet. With the addition of mobility, telephones become as popular as wristwatches, and the combination of the two opens the way for access to the Internet anywhere, any time. We are clearly talking about a new era.

Deregulation spreads across Europe

- As a result of deregulation, a constant stream of new operators entered the markets. One of the most challenging questions of the research for this book was how deregulation spread so rapidly. What forces drove authorities to remove obstacles in the 1980s, facilitating the explosive growth of the industry in the 1990s, is a fascinating and difficult topic, but one that is beyond the scope of this book.

The field of telecommunications includes three groupings - operators, equipment manufacturers and regulators. The most important grouping is the operators, who aim to attract paying customers to services on their networks. Operators offer services by building networks on which they carry voice and data. For this purpose operators purchase infrastructure, i.e. networks and systems developed by equipment manufacturers. The equipment includes digital switching, radio base stations and base station controllers as well as handsets. Consumers only purchase handsets.

The fixed copper wire or fiber-optic networks that traditionally have carried voice have expanded to carry data and other information services.

The new mobile and digital era brought about new services - a prime example is the Short Message Services (SMS), which annually amounts to billions of messages in Finland - a country of five million people.

It is easier to describe the expansion of deregulation than to explain its birth. Anti-trust legislation in the United States goes back to the beginning of the 20th century and the court cases against John D. Rockefeller's oil interests. The slicing up of AT&T into `Baby Bells' by the US authorities in the mid-1980s directly follows from the first anti-trust cases. Another root of deregulation originates in Britain where Conservative Prime Minister Margaret Thatcher adopted the principles of the Milton Friedman `Chicago school' of monetarism. As per her strong political convictions, competition and market forces were to be introduced into as many areas of the public sector as possible.

The European Community (later European Union) began to awaken from its `Eurosclerosis' in the early 1980s, marking another key phase in deregulation. The EU gradually moved toward uniformity and true common markets, making a great impact on telecommunications. The GSM mobile phone standard was arguably one of the EU' s most successful achievements, but globally the problem is more complex. Currently, the most pressing battles in communications concern the creation of international standards, and the technical architecture of the third generation mobile phones. Global telecom companies are in constant turf fights all over the world.

The more I have studied the present change and the more research I have accumulated, the better I like the definition the `third industrial revolution' - emphasis on the traditional word `industrial'. The air is dense with hyperbole - superlatives and phenomena without precise content. This is why the history of Nokia is best regarded as a straightforward industrial history, an analysis of the development, production and sale of industrial products.

Products made by Nokia have enjoyed very strong demand in recent years, and they have played a part in the transformation of Finnish society, and even the world. Yet before comparing Nokia's impact on any society, cellphones should be compared with two earlier industrial revolutions. Inventions such as the steam engine, electricity, the automobile, television, the jet engine - and the fixed line telephone - have transformed human life even more than the mobile phone.

From an individual citizen's perspective, I would be inclined to brush all these aside and elevate television above the rest as it truly shrank the globe and changed the nature of local communities by opening their windows onto the global village.